

Unit 5

Repairing of Cable Joints

INTRODUCTION

Electrical joints and terminations provide the required electrical connection as well as the mechanical support and physical protection to the cable. It is important for the Cable jointing system to suit the service and operational requirements for all industrial cable jointing environments and applications. These devices are important for jointing the cables and wires. A good cable jointing and installation provides a better

supply of power (Fig. 5.1). Cable jointing has become the preferred pick over conventional systems for cable termination, cable abandonment, low voltage cable jointing and cable repair. The cable termination and jointing kits are often specialised in wire installations worldwide.

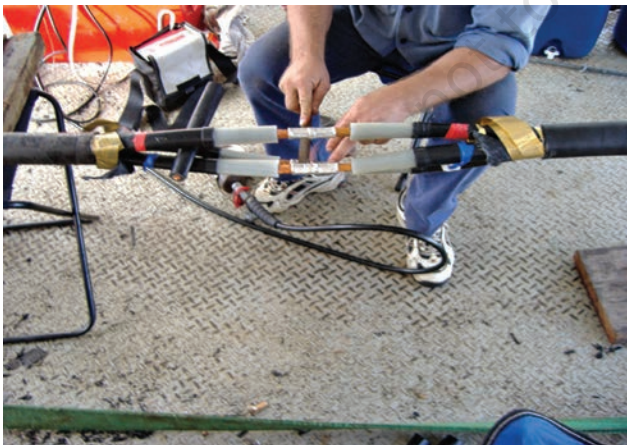


Fig. 5.1 Electrical joint and terminations

Cables play a very important role in the distribution system of power. There are different types of cables like LT cable, 11 KV cable and 33 KV cable. Cables are used in places where bare

conductor cannot be used due to narrow roads. Cables are costlier than the conductor and the same cannot be replaced often.

SESSION 1: ELECTRICAL CABLE JOINTING

METHODS

Jointing of power cables should be as simple as twisting and taping the wire. For jointing of a cable variety of in-line adapters and connectors are used. The method used for a cable joint depends on the voltage, type of cable, type of joint, type of connector, application and other factors. Proper tools and equipment are to be used for jointing the cable.

Given below are some important factors to ensure reliable connections, such as

- proper size of connectors should be used for a particular cable,
- proper tools and equipment are to be used,
- cuts and stripping should be very clean,
- proper technique is to be used for cable jointing and
- restoring the insulation, outer-sheath and armour.

Western Union Splice Joint

The cables are manufactured for a particular length. To increase the length of a cable a straight joint is used for small solid cables (Figs. 5.2 and 5.3).

1. Remove the insulation of cable
2. Bring the two conductors to a crossed position and then make a long bend or twist in each wire.
3. Wrap the end of one of the wires around the straight portion of the other wire, and then do the same for the other wire. Repeat this for about four or five times.
4. Press ends of the wires down close to the straight portions of the wire to prevent the ends from piercing through the insulation tape.
5. Insulate the joint using the insulation tape

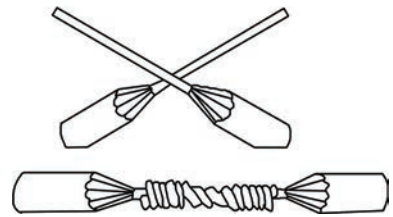


Fig 5.2 Western union splice and straight joints

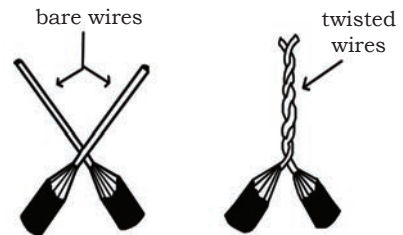


Fig. 5.3 Rattail joints

Fixture Joint

This is a type of branch joint connecting a thin wire (for branch line) to the thick wire (main line), such as those used in lighting fixtures.



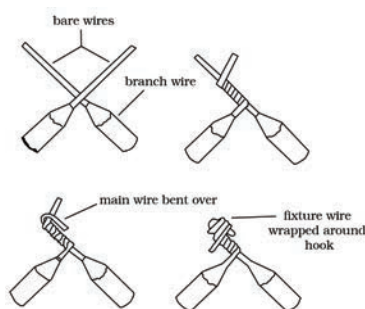


Fig. 5.4 Fixture joint

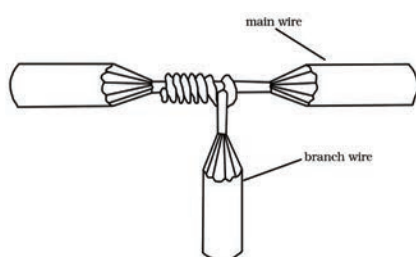


Fig. 5.5 Knotted tap joint

1. Remove the insulation of wire
2. Wrap the fixture wire around the branch wire
3. Bend the branch wire over the completed turns
4. Wrap the remaining fixture wire over the bent branch wire
5. This can be followed by soldering and taping, or simply taping of the joint (Fig. 5.4).

Knotted Tap Joint

The knotted tap joint is also used for branch joints to connect a branch wire (thin wire) to a continuous or main wire (thick wire) (Fig. 5.5).

1. Remove about 1 inch of insulation from the main wire and about 3 inches from the branch wire.
2. Place the branch wire behind the main wire so that three-fourths of its bare wire extends above the main wire.
3. Bring the branch wire over the main wire, around itself, and finally over the main wire so that it forms a knot. Wrap the wire around the main conductor in short, tight turns and trim the end

Joints Using Wire Nut and Split Bolt

The rattail joint is replaced by wire nut. The nut is usually housed in a plastic insulating casing. To make a joint.

1. Strip the conductors
2. Place the two joints to be joined into the wire nut
3. Twist the nut

Split Bolt Connector

The split bolt is used to join big sized conductors. This replaces the knotted tap joint and can be used to join three ends or join a branch conductor to a continuous (main) conductor (see Fig. 5.6).

The bare wires are placed through the space between the two bolts, after which the nut is tightened to ensure



a sound joint. The material required for making straight or branch joints for steel wired armour cables are as follows:

- Connectors
- Copper mesh tape
- Constant force springs for holding the wire armour and copper mesh tape
- Standard PVC/Vinyl tape, which provides a mechanical barrier between the over sheath layer and the armour layer.



Fig. 5.6 Split bolt

Preparing the Cable

Preparing the cable before jointing includes the following steps (Fig. 5.7):

1. Remove the over sheath and the wire armour
2. Separate the wire armour and bend the wires away from the cable, place the support ring under the armour at each side of the joint
3. Cut back the cable insulation
4. Remove the insulation from each of the conductors

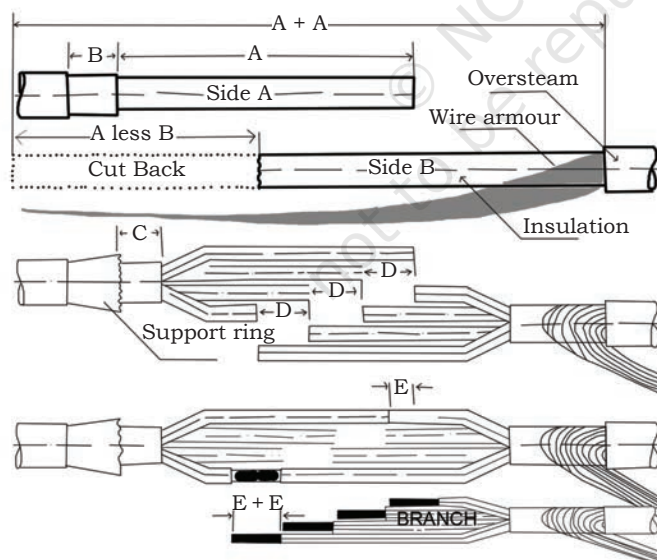


Fig. 5.7 Preparation of a three-core armoured cable

Crimping and Insulating Each Cable

Once the cable is ready, connect each end of the three conductors to a suitable connector (copper or

REPAIRING OF CABLE JOINTS



aluminium). Suitable-sized connectors are to be used. Tightly fix the suitable connectors and test the connection.

Tape the crimped connectors, wrap around and extend to cover at least 25mm of the cable insulation of the conductor entering the connectors (Fig. 5.8).

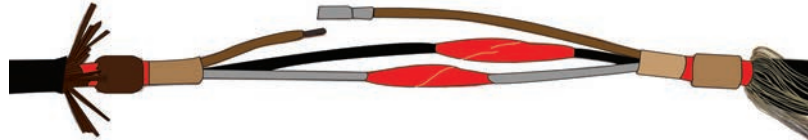


Fig. 5.8 Taped, crimped connectors on individual cables



Fig. 5.9 Wires taped together

Binding the Cables

Bind the wires tightly and then tape them together (Fig. 5.9).

Restoring Armour and Applying Mesh Tape

1. Tightly wrap the cable from armour to armour while applying adequate tension around the insulation.
2. Join the wire armour from one end to the other end and cut excess wire to the correct length. Ensure the armour spreads evenly over the entire joint.
3. Wrap the cable with the mesh tape and then use the standard vinyl/PVC tape to wrap over the mesh to provide a insulation against stray wire ends. For the branch joint, bring both the main and branch cables together before wrapping.



Fig. 5.10 Wrapping the cable with mesh tape

Next, use standard vinyl or PVC tape to wrap over the constant force springs placed over the under-armour rings. The tape provides a barrier against sharp edges (Fig. 5.10).

Re-establish the Over Sheath

1. Use a self fusing tape to wrap over the cable and establish the outer sheath. Start in the center and apply one layer of tape to one end, wrapping



over the jacket for at least 25 mm. Apply the tape from the end towards the center so that you have two layers on each side.

2. For branch joints, wrap over the insulation for both the main and the branch cable, by at least 50mm. Bring the two together and fill it in with the insulating putty from both sides. Do this up to 25 mm away from the place where the branch and the main cables are joined.
3. Put the two cables together and bind the main and branch tightly over the filling. Finally, wrap the crotch while pulling the branch away from the main cable (Fig. 5.11).

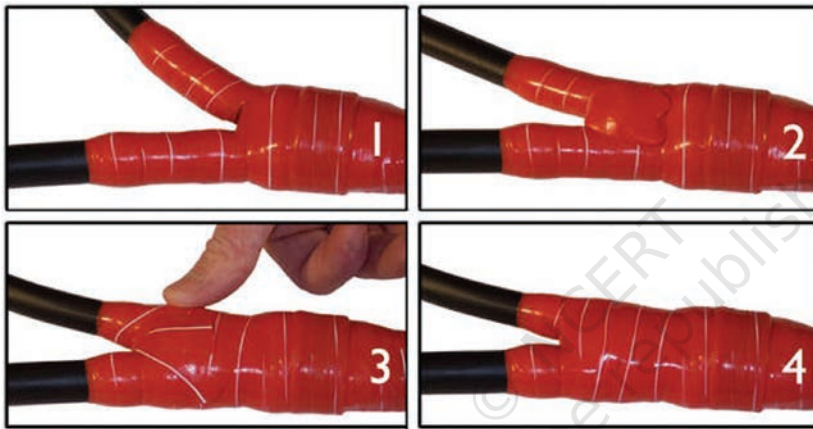


Fig. 5.11 Restoring the over sheath on a branch joint

Electrical Power Cable Terminations

The electrical cable termination is a cable end that connects to the terminal of the equipment or another cable to extend the length (Fig. 5.12).

The method used for termination of the cables varies according to the type of cable, type of connector and application. Some common types of terminations are

- crimp connection
- soldered connection
- compression termination
- wire-wrapping connection
- direct connection
- loop or eye connection

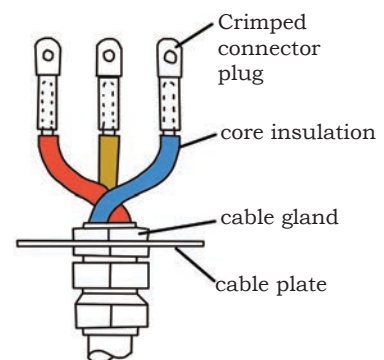


Fig. 5.12 Low voltage cable termination



Some of the factors which are considered for termination of cables are:

- Outdoor or indoor cable
- Voltage of the line
- Overhead or underground cable
- Type of connector on the equipment where the cable will be connected

Cable Joints

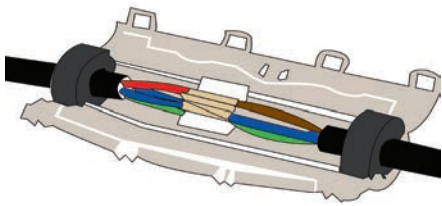


Fig. 5.13 Cable joint

A power cable consists of two or more electrical conductors, held together wrapped with insulation and outer surface with an overall sheath (Fig. 5.13). The cables are used for transmission of electrical power. Power cables are being used for permanent wiring within buildings. The cable can be run underground, run overhead, or exposed. Cables consist of three major components: conductors, insulation and protective jacket. The structure of individual cables varies according to application. Power cables use stranded copper or aluminium conductors, although in some cases solid conductors are used.

After the introduction of electric cables in electrical circuit the problem of how to join them together arises in order to achieve the degree of insulation, tensile and crushing strengths, conductivity and accessibility. To cope up the requirements a junction box is introduced. The junction box typically incorporates:

- a method of securing the cable conductors (usually by soldering, screw-clamps or compressed ferrules).
- a method of insulation, which may be air, oil, bitumen or insulation applied in the form of tapes.
- a method of enclosure and protection applicable to the environment.

As per The Electricity Regulations every joint and connection should be mechanically and electrically suitable for its use. In this respect the joint or connection should be of proper construction as regards conductivity, insulation, mechanical strength and protection.

Joints in Non-flexible Cables

Underground cables are joined by ferrules or lugs (crimped) and the outer protection enclosure or box is



usually filled with a plastic or bituminous compound. Such joints are often used above-ground for non-flexible cables and are adequately protected and supported. Other cables which are fixed wiring installations enclosed junction boxes are used to making a joint between two cables. These junction boxes are not securing the cable against strain.

Joints in Flexible Cables

Joints in flexible cables are not usually satisfactory because:

1. stranded conductors are not suitable for certain methods of jointing.
2. mechanical tensile strength and resistance are difficult to maintain.
3. fatigue damage may occur when rigid joint is being done.

Some joints and cable connectors are much more acceptable these incorporate terminals or compression fittings suitable for stranded conductors. Cable clamps are used for plugs to reduce the flexing. Heat-shrinkable or pre-stretched sleeving may be adequate in some cases but other circumstances may demand additional protection.

Types of Cable Joints and Equipment

A great majority of failure in cable network is associated with faulty cable jointing. It is, therefore, essential to use proper jointing technique, good quality insulating material and standard accessories for cable jointing. Cable joints are of three types:

Straight through Joint

Straight through Joints are an important part of today's power cable networks (Fig. 5.14). These joints offer reliability and flexibility to meet the demands of cable network.

Straight through Joints provide

- quick cable preparation
- high electrical insulation
- no moisture ingress

REPAIRING OF CABLE JOINTS

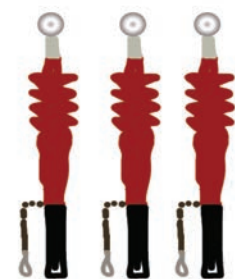


Fig. 5.14 Single Core Straight through Joint Kits



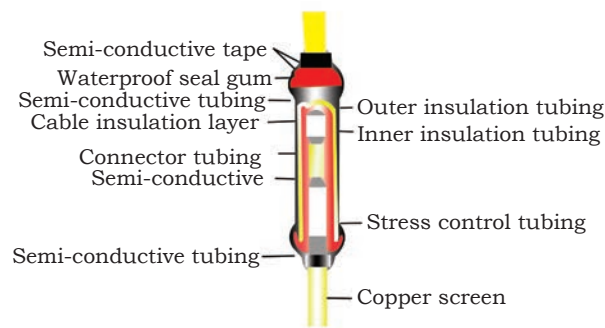


Fig. 5.15 Straight through Joint

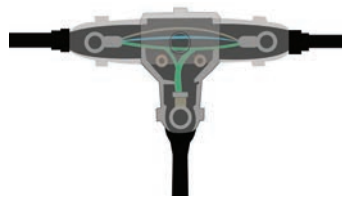


Fig. 5.16 T-Joint



Fig. 5.17 Terminal Joint

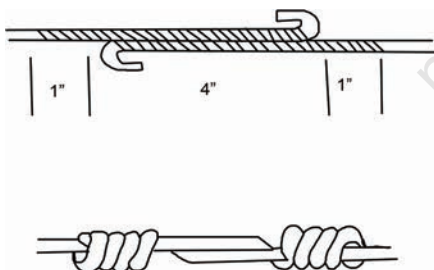


Fig. 5.18 Britannia Joint

- good mechanical strength
- compact dimensions and is suitable for all conductor, shape and material

Straight through Joints are made by metal joining processes, such as welding and soldering (Fig. 5.15).

T-Joint

These types of joints are used for branching of a service cable from a main cable.

T-joints are helpful as turning and twisting of cable damages its outer core (Fig. 5.16).

Terminal Joint

These type of joints connect cable to switch gear, transformer terminal or to an overhead line (Fig. 5.17).

Conductor Joint

The length of distribution lines are in kilometers and one coil of conductor is unable to solve the length problem. Hence, jointing the conductor is necessary.

Britannia Joint

This type of joint is made only on solid conductors and cannot be made on stranded conductor. Two conductors to be joined are brought in front of each other of about 6 inch (150 mm) of length. Both the conductors should be clean. If the conductor is of copper; it should make good electrical connection. Then ends of both conductors are bent through half centimetre and placed on each other. The length of contact portion should be min. 100 mm. This joint should be bound by 14 mm copper wire as shown in Fig. 5.18.

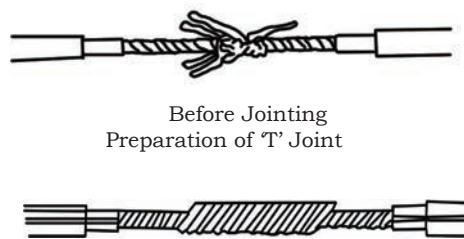
Telephone Joint (Western Union)

This joint is used only for solid conductors. It is used for conductors of size 8 SWG or higher size. First, bend is given at 100 to 125 mm from the edge and are placed over each other. Then each one is twisted with another conductor.



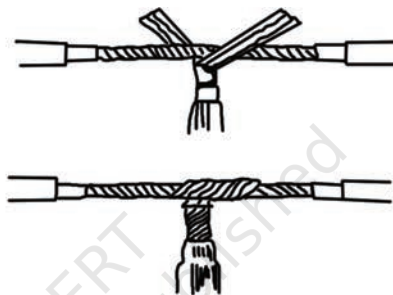
Married Joints

This joint is made between copper conductors having central strand of GI wire (Fig. 5.19). It should not be made between aluminium (Al) conductors. Approximately 175 to 200 mm length conductor strands are unwound. The GI strand of both conductors should be broken up to 175 mm in length. Both conductors should be brought in front of each other and their strands should be woven in each other. The strand of one conductor is twisted on other conductor, and strand of other conductor is twisted on the first. Likewise all the strands twisted and then soldered. This is used only for small span length.



Before Jointing
Preparation of 'T' Joint

After Jointing
Fig. 5.19 Married Joint



'T' Joint After Completion
Fig. 5.20 'T' Joint

Sleeve Joint

It can be made with any type of aluminium conductor. Graphite Grease is applied over the conductor and as shown in Figs. 5.20 and 5.21 sleeves should be taken. These sleeves should be placed on the conductor as shown. Sleeves should be twisted by twisting wrench. This joint is made for LT, HT, ACSR, AAC conductor up to 0.06 cm^2 .



Fig. 5.21 Sleeve Joint

Compression Joint

This joint is used for conductors of more than 0.06 cm^2 sizes. For jointing, two different sleeves are used. Steel sleeve is used for steel conductor strands and aluminium sleeve is used for Al. conductor strands. There are two holes in Al. sleeve. Rebating is done



through these holes. Then Al. sleeve to be mounted on one side. The length of steel sleeve is then measured. Its half distance is taken. Suppose it is 'X' cm. Then the ends which are to be joined and more to 'X' cm distance is taken on the conductor is banded there. The Al. strands are opened up to that point and cut. Steel strand should not be touched during this. They are placed in the steel sleeve. They should be kept in front of each other. Then the center of steel sleeve is compressed through compression machine. Then on the half portion of the right side sleeve be compressed and then on the left half portion. Due to compression the length of sleeve will be increased by 6mm on both sides and it will reach Al. strands. Then Al. sleeve should be measured. It should be halved. Suppose it is 'Y' cm then 'Y' cm should be measured and marked on both sides of conductor measured from center of steel sleeve. Both parts of conductor are brought in sleeve in front of each other. The filler parts should be filled in the sleeve by Grease until it comes out of the holes. Both the holes are then closed by rivets and hammered by hammer. There is one stencil mark on Al. sleeve. The first compression will be there; afterwards it will be compressed up to one end. Similarly the other part is compressed up to the other end.

Jumpering

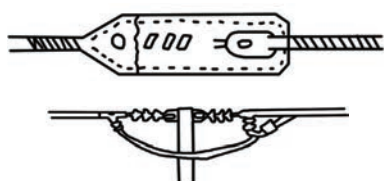


Fig. 5.22 Jumpering

Connecting two conductors or wires is called jumpering (Fig. 5.22).

Jumper should not be connected to the main conductor. The jumper should always be connected by PG clamps.

When the jumpers are near metallic portion, all such jumpers are covered with alkathane pipe.

Conductor joints are marked on ACSR conductor when dispatched. Mid-span joint should be made before stringing as the steel strand is not kept continuous. Hence, it is necessary to replace the company joint.

Care should be taken that mid-span joint is not less than 40 ft. from pole. Every joint should be done carefully.

Where conductor strands are cut, repair sleeve is used. Conductor joint strength should be 95% that of conductor, and resistance should be that of a main conductor.

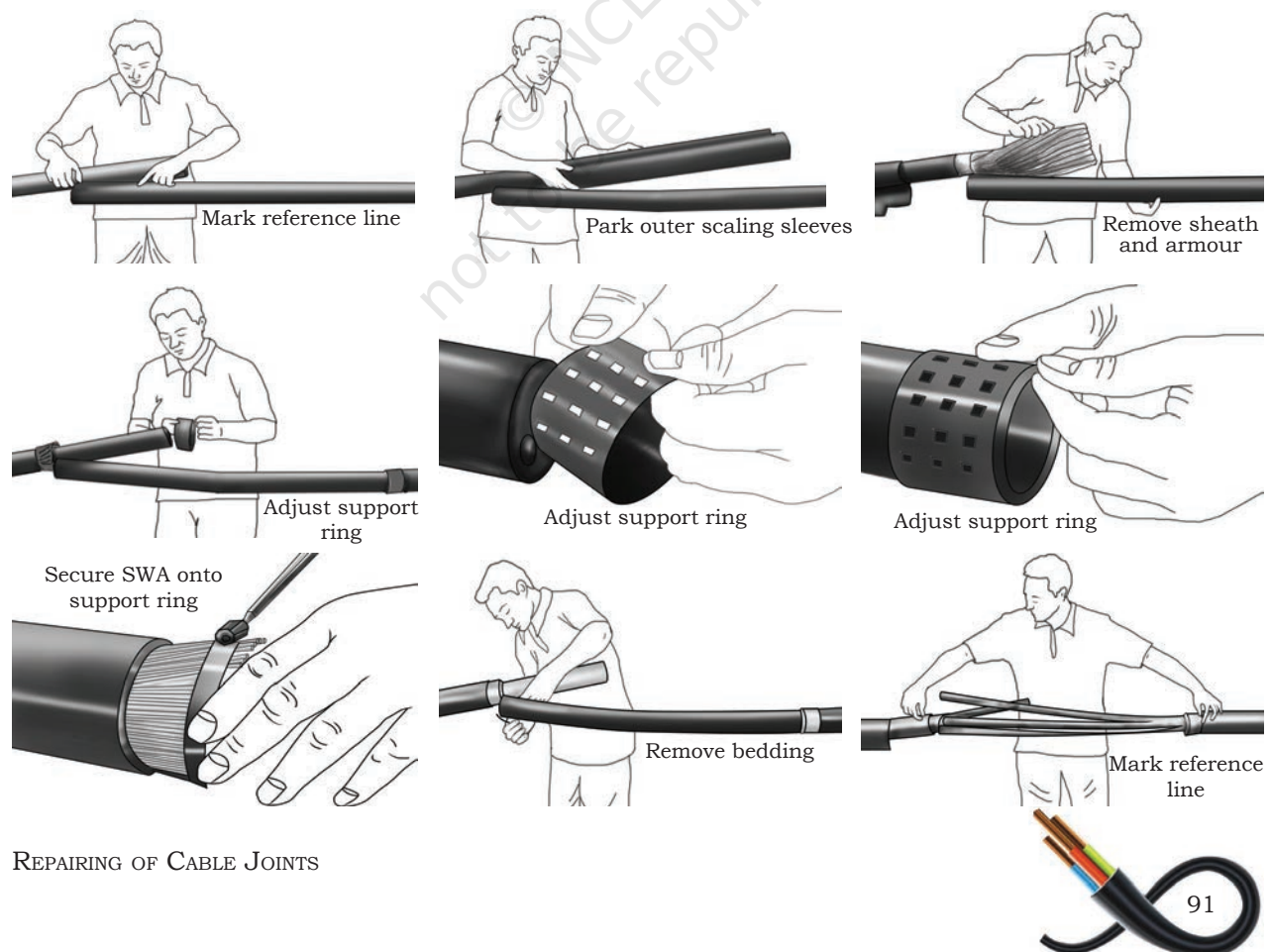


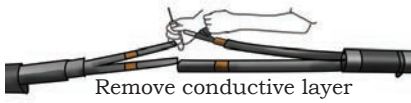
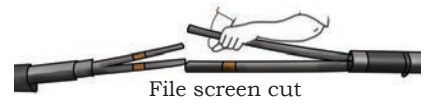
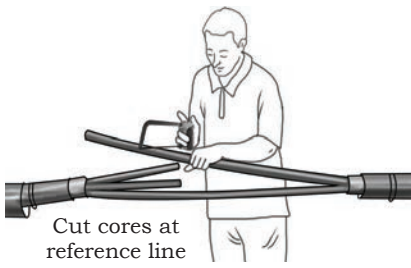
HV Cable Jointers Tools

Using the correct cable tools to prepare industrial and utility cables before cable jointing and terminating reduces catastrophic cable failures. Some of the important cable jointer tools include:

- Cable cutting tool
- Cable crimping tool (hydraulic, battery, ratchet) copper/aluminium cables
- Cable spiking tools for LV-HV cables (cartridge/hydraulic)
- Heat shrink gas torches for LV-HV jointing
- Screen scoring tools for bonded/easy peel HV cables
- Outer sheath stripping tools, LV-HV cables
- Insulation (XLPE) stripping tools, HV cables
- Insulated tools for live-working
- Cable laying rollers, socks, jacks and pulling equipment
- Conduit duct rods

Procedure for Heat Shrink Straight through Joint





Check Your Progress

A. Write short notes on

1. LT cables Joints
2. Straight through joint
3. Britannia Joint
4. T-joint

B. State whether the following statements are True or False

1. Western Union joint are used for all conductors.
2. Meried joint should not be made between aluminium conductors.
3. Crimping is necessary for jointing the cable.

C. Short answer questions

1. List the steps used in preparing of the cable.
2. Explain the different types of joints.
3. Differentiate between fixture joint and western union splice joint.
4. Explain the procedure for heat shrinking straight through joint.

